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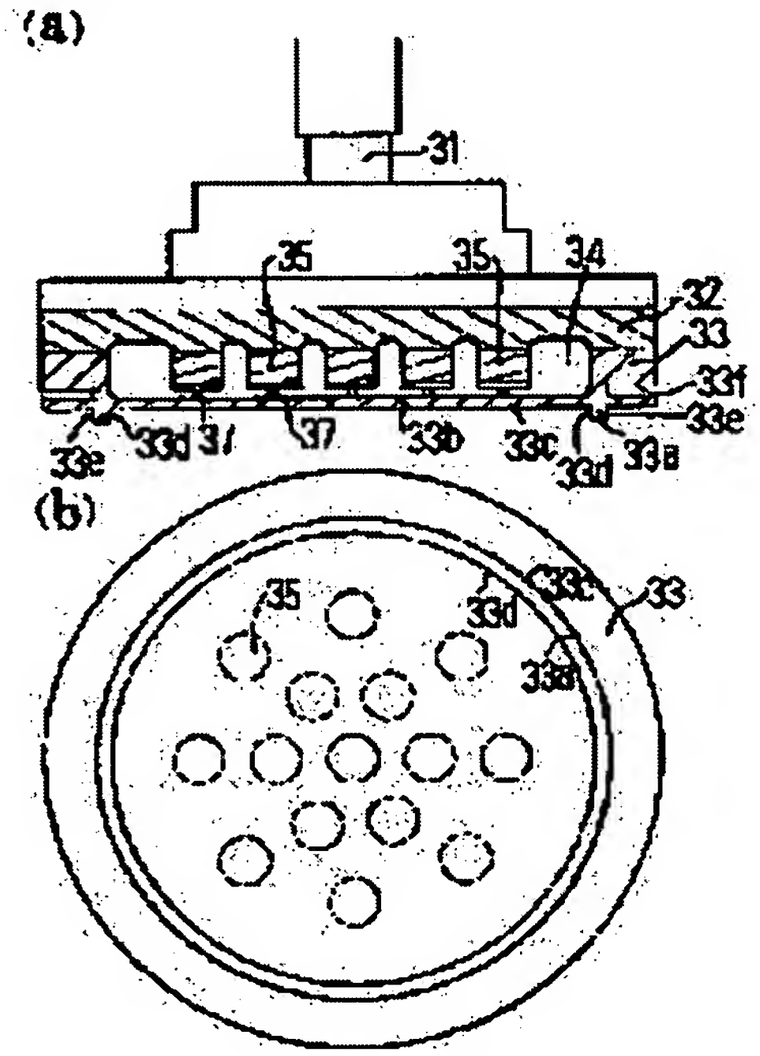
(54) GRINDING DEVICE OF SEMICONDUCTOR SUBSTRATE

(57)Abstract:

PURPOSE: To secure uniformity within a semiconductor substrate of a grinding amount in a single-leaf type grinding device of semiconductor substrate (wafer).

CONSTITUTION: An outer surface 33c (a contact surface of a semiconductor substrate) of a substrate mounting part 33b is outwardly swollen to be a curve surface shape. Further, this is attached to the semiconductor substrate pressed against abrasive cloth and the semiconductor substrate is bent along the outer surface 33c by an elastic force of abrasive cloth. Thus, it is possible to make uniformer a surface inside distribution of conventional process pressure, particularly the surface inside distribution in which elasticity of the abrasive cloth acts largely on a peripheral part of the semiconductor substrate to elevate process pressure of the part. The uniformity inside the surface of a grinding amount is secured more. A curve surface shape is formed, as shown in Fig. 1, by driving a piezo-element, a super-magnetostrictive alloy, etc., 35. Also, it may be fixedly formed.



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CLAIMS

[Claim(s)]
[Claim 1] It is polish equipment of the semi-conductor substrate characterized by for the outside surface of the semi-conductor substrate attachment section of the above-mentioned plate for substrate adsorption to be the curve side configuration which swelled to the method of outside in the polish equipment of the semi-conductor substrate which make abrasive cloth intervene, make the semi-conductor substrate attached in the semi-conductor substrate attachment section of the plate for substrate adsorption attached in the rotation carrier for polish counter a turn table, and grinds the front face of the above-mentioned semi-conductor substrate with the above-mentioned abrasive cloth.
[Claim 2] The curve which met the outside surface of the above-mentioned semi-conductor substrate attachment section of the above-mentioned semi-conductor substrate in claim 1 is polish equipment of the semi-conductor substrate characterized by pressing the above-mentioned semi-conductor substrate to the above-mentioned abrasive cloth, and being made.
[Claim 3] Set to claim 1 or claim 2, and while the above-mentioned rotation carrier for polish, and the above-mentioned plate for substrate adsorption, width-of-face adjustable materials, such as a piezo-electric element and a giant magnetostrictive alloy, intervene in the above-mentioned plate for substrate adsorption. Polish equipment of the semi-conductor substrate characterized by for the above-mentioned semi-conductor substrate attachment section having countered the above-mentioned width-of-face adjustable material, being able to drive the above-mentioned width-of-face adjustable material, and being able to change the curve side configuration of the outside surface of the above-mentioned semi-conductor substrate attachment section.
[Claim 4] Polish equipment of the semi-conductor substrate characterized by the hard ball intervening between the above-mentioned width-of-face adjustable material and the above-mentioned semi-conductor substrate attachment section in claim 3.
[Claim 5] For the notch for reducing [in / on claim 3 or claim 4 and / the outside location of the above-mentioned semi-conductor substrate attachment section] the rigidity of the outside location of the above-mentioned semi-conductor substrate attachment section, the above-mentioned plate for substrate adsorption is polish equipment of the semi-conductor substrate characterized by being formed in a circumferencial direction.
[Claim 6] It is polish equipment of the semi-conductor substrate characterized by forming the above-mentioned semi-conductor substrate attachment section by stainless steel or phosphor bronze, and carrying out the Teflon coat of the outside surface of the above-mentioned semi-conductor substrate attachment section in any one of claim 3 - the claims 5.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention makes abrasive cloth intervene, makes the semi-conductor substrate (wafer) attached in the semi-conductor substrate attachment section of the plate for substrate adsorption attached in the rotation carrier for polish counter a turn table, and relates to the polish equipment of the semi-conductor substrate which grinds the front face of a semi-conductor substrate with abrasive cloth.
[0002]
[Description of the Prior Art] The demand which reduces the device level difference in a chip when processing a detailed pattern is increasing increasingly as high integration of ULSI progresses. Especially in the logic IC which makes laminating wiring structure indispensable, this poses a serious problem. In order to solve this problem, examination of the formation of global flush has been performed.
[0003] and -- as the technique in which global flush-ization can be attained -- especially -- chemical machinery polish (it abbreviates to CMP Chemical-Mecanical-Polishing and the following) -- law is capturing the spotlight.
[0004] And in the CMP method, process margins, such as RIE and PVD, are extended more and the homogeneous improvement in the amount of polishes between semi-conductor substrates within the field of the same semi-conductor substrate (polish removal rate) serves as an important theme from the need of detecting the alignment mark of FOTORISO more easily.
[0005] Generally the amount of polishes of the CMP method can be expressed with Preston (Preston) type;(dT/dt) =kxPx (ds/dt) here. They are T:thickness, k:proportionality constant, P:processing pressure force, the amount of displacement of the any selected point in s:substrate (movement magnitude), and t:time amount here. k is a constant it is decided with an abrasive material and abrasive cloth that will be the quality of abrasives-ed. Moreover, distribution of ds/dt in a substrate can be equalized by making equal angular velocity of a turn table and the rotation carrier for polish. Namely, in the polish equipment of one shafting of single wafer processing shown in drawing 7 , X and a Y-axis are taken by making the core of a polish disk (circle O1) into a zero. the angular velocity of the semi-conductor substrate (circle O2) which rotates the angular velocity of a polish disk with omega 1 and the rotation carrier for polish -- omega 2 ** -- if it carries out -- the rate u of the any selected point P on a semi-conductor substrate -- u=(R1+R2) omega1-R2 omega2 = (omega1-omega2) R2+omega one R1 It becomes. It is R1 here. The distance vector between the core of a polish disk (circle O1), and the core of a semi-conductor substrate (circle O2), and R2 It is a distance vector between the core of a semi-conductor substrate (circle O2), and an any selected point P. Therefore, omega1 =omega2 It solves and is u=omega one R1. It becomes and is R2. It does not depend but is omega 1. R1 Since it becomes a function, it is omega 1. R1 If it is made to fix, u will have fixed vector quantity within a substrate. That is, a velocity distribution is lost.
[0006] Therefore, in a Preston style, since it can equalize within k and (ds/dt) a substrate, in order to make the amount of polishes into homogeneity, it becomes important to make the field internal division cloth of the polishing pressure force P into homogeneity.
[0007]
[Problem(s) to be Solved by the Invention] however, in order that the abrasive cloth stuck on the turn

table may contact a semi-conductor substrate, the thrust to the semi-conductor substrate of abrasive cloth has the problem of surely becoming larger by the periphery of a semi-conductor substrate (reference; -- the 71-85 page:Toshiro Dohi work of the CMP seminar text February 23 or 24, 1993 issues, and Sponsorship rear rise company). That is, if the semi-conductor substrate 61 by which this is adsorbed since the plate for substrate adsorption is brought as much as possible close to a flush side in the usual polish as shown in drawing 8 (a) also serves as a flush side, abrasive cloth 62 contacts the semi-conductor substrate 61 of this plate-like voice and the predetermined processing pressure force W acts, a pressure P will concentrate around a substrate in connection with the elastic deformation of abrasive cloth 62. Therefore, if it grinds in this condition, finally the substrate circumference will be in the substrate configuration condition that pressure distribution become homogeneity more, greatly (this drawing (b)), and polish processing will also end the amount of polishes (polish removal rate) (this drawing (c)).

[0008] The problem of the concentration to the substrate circumference of the pressure accompanying the elastic deformation of the above-mentioned abrasive cloth Whenever [of a turn table] flush [, and], the problem of the heterogeneity of the processing pressure force P accompanying manufacture precision, such as polish equipments, such as thickness unevenness of abrasive cloth and field blurring of the turn table at the time of rotation, and abrasive cloth, etc. differs [of the plate for substrate adsorption] from a problem solvable enough by improvement in manufacture precision. Since it is a problem on the structure which a grinder style originally has, in order to fully raise polish precision, it is very important to fully cancel the defect on the structure.

[0009] Then, the purpose of this invention is to offer the polish equipment of the semi-conductor substrate which the defect on the above-mentioned structure is fully canceled, and the homogeneity of the thrust to the semi-conductor substrate of abrasive cloth is secured, with can acquire the homogeneity of the amount of polishes.

[0010]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the outside surface of the semi-conductor substrate attachment section of the plate for substrate adsorption is the curve side configuration which swelled to the method of outside in the polish equipment of the semi-conductor substrate which this invention makes abrasive cloth intervene, makes the semi-conductor substrate attached in the semi-conductor substrate attachment section of the plate for substrate adsorption attached in the rotation carrier for polish counter a turn table, and grinds the front face of a semi-conductor substrate with abrasive cloth.

[0011] The curve in alignment with the outside surface of the semi-conductor substrate attachment section of a semi-conductor substrate presses a semi-conductor substrate to abrasive cloth, and may be made.

[0012] While the rotation carrier for polish, and the plate for substrate adsorption, width-of-face adjustable materials, such as a piezo-electric element and a giant magnetostrictive alloy, intervene in the plate for substrate adsorption, the semi-conductor substrate attachment section has countered the width-of-face adjustable material, a width-of-face adjustable material is driven, and you change the curve side configuration of the outside surface of the semi-conductor substrate attachment section.

[0013] The hard ball may intervene between a width-of-face adjustable material and the semi-conductor substrate attachment section.

[0014] A width-of-face adjustable material is driven, and when the curve side configuration of the outside surface of the semi-conductor substrate attachment section can be changed, the notch for the plate for substrate adsorption to reduce the rigidity of the outside location of the semi-conductor substrate attachment section in the outside location of the semi-conductor substrate attachment section may be formed in the circumferencial direction.

[0015] A width-of-face adjustable material is driven, when the curve side configuration of the outside surface of the semi-conductor substrate attachment section can be changed, the semi-conductor substrate attachment section is formed by stainless steel or phosphor bronze, and the Teflon coat of the outside surface of the semi-conductor substrate attachment section may be carried out.

[0016]

[Function] From a Preston style, a polish removal rate can be made into homogeneity, when the

polishing pressure force is equal. Therefore, a semi-conductor substrate is incurvated beforehand, and if it grinds by [as the pressure distribution when pressing abrasive cloth becoming more uniform], the amount distribution of polishes within a more uniform substrate side will be acquired. And after polish termination, if the curve of a semi-conductor substrate is returned to the original plate-like voice, the plate-like semi-conductor substrate which has the final more uniform amount distribution of polishes will be obtained. By the way, since a semi-conductor substrate is attached in the outside surface of the semi-conductor substrate attachment section of the plate for substrate adsorption, if this outside surface is beforehand made into a curve side and a semi-conductor substrate is incurvated along with this, a semi-conductor substrate can be incurvated.

[0017] Since abrasive cloth has predetermined thickness and has predetermined elasticity if a semi-conductor substrate is pressed to abrasive cloth after attaching a semi-conductor substrate in the outside surface of the semi-conductor substrate attachment section, a semi-conductor substrate is pushed back by abrasive cloth and curves along with the outside surface of the semi-conductor substrate attachment section. Therefore, even if it does not establish a means to incurvate a special semi-conductor substrate along with an outside surface, thereby, a semi-conductor substrate can be incurvated.

[0018] The semi-conductor curve side configurations where pressure distribution become homogeneity in a field by the thickness of abrasive cloth, the elastic modulus, the size of the processing pressure force, etc. differ. Therefore, it is desirable that it can carry out adjustable [of the curve side configuration of the outside surface of the semi-conductor substrate attachment section]. While the rotation carrier for polish, and the plate for substrate adsorption, width-of-face adjustable materials, such as a piezo-electric element and a giant magnetostrictive alloy, are made to intervene in the plate for substrate adsorption, this is driven, and the curve side configuration of the outside surface of the semi-conductor substrate attachment section can be changed into arbitration by carrying out the variation rate of the semi-conductor substrate attachment section which counters this.

[0019] If the hard ball intervenes between a width-of-face adjustable material and the semi-conductor substrate attachment section, since a width-of-face adjustable material will give the displacement force not as a field but as a point at the semi-conductor substrate attachment section, the smooth curve side configuration which does not have distortion in the outside surface of the semi-conductor substrate attachment section more can be given.

[0020] When incurvating the semi-conductor substrate attachment section with a width-of-face adjustable material, the curve near the edge of the semi-conductor substrate attachment section can fully be obtained by forming in the outside location of the semi-conductor substrate attachment section of the plate for substrate adsorption the notch which reduces the rigidity of this part.

[0021] Since plastic deformation is prevented and shearing stress can fully be borne by making the semi-conductor substrate attachment section into stainless steel or phosphor bronze when incurvating the semi-conductor substrate attachment section with a width-of-face adjustable material, a desired curve side is maintained and it becomes possible repeatedly to make the curve side. Moreover, mixing of the metal impurity to a semi-conductor substrate is prevented by having carried out the Teflon coat to the outside surface.

[0022]

[Example] Hereafter, the example of this invention is explained to a detail based on a drawing. First, the 1st example of this invention is explained. This example is an example of the polish equipment of one shafting of single wafer processing, and the rotation carrier 2 for polish is attached in the carrier support shaft 1 in drawing 2 . In this example, the carrier support shaft 1 is constituted so that it may rotate with an angular velocity equal to the below-mentioned turn table.

[0023] And the plate 3 for substrate adsorption is attached in the rotation carrier 2 for polish. Guide 3a for substrate immobilization is prepared in the plate 3 for substrate adsorption at the periphery section. The inside of guide 3a for substrate immobilization is set to semi-conductor substrate attachment section 3b. Guide 3a for substrate immobilization prevents that a semi-conductor substrate escapes from and comes out of semi-conductor substrate attachment section 3b during polish. Outside-surface 3c of semi-conductor substrate attachment section 3b is the clamp face of a semi-conductor substrate, and has become the curve side configuration which swelled to the method

of outside. The non-illustrated adsorption hole is prepared in semi-conductor substrate attachment section 3b. an adsorption hole -- semi-conductor substrate attachment section 3b and the same axle -- guide 3a for substrate immobilization -- comparatively -- alike -- the periphery top of the diameter of predetermined of a near location (for example, two thirds of paths of the path of a semi-conductor substrate) -- for example, eight pieces are prepared (refer to drawing 5). A non-illustrated vacuum pump is connected behind an adsorption hole, and the open air is inhaled from an adsorption hole by driving this. A semi-conductor substrate is attracted by outside-surface 3c with this suction force, and it is handled and conveyed. The configuration is determined so that, as for curve side configuration 3c of an outside surface, the configuration of a semi-conductor substrate may turn into a predetermined curve side configuration with more uniform thrust also to the suction force by the adsorption hole conjointly, when a semi-conductor substrate is pressed to abrasive cloth so that it may mention later. Moreover, two or more kinds of curve side configuration 3c is prepared by polish conditions, such as thickness of a semi-conductor substrate, thickness of abrasive cloth, an elastic modulus, and size of the processing pressure force. Semi-conductor substrate attachment section 3b is united with the plate 3 for substrate adsorption, and is not invaded chemically, but is manufactured by the quality of the material of the quality of the material with little deformation, for example, a ceramic, glass, etc. to a load. In addition, you may be plastics, as long as it excels in pressure resistance nature and is rich in endurance.

[0024] Next, the non-illustrated turn table is formed in disc-like, and is formed with the quality of the material which is not invaded chemically [stainless steel, the ceramics, etc.].

[0025] Next, it has fixed polish capacity, the quality of the material of the quality of the material which has fixed frictional resistance, a moderate elastic modulus (hardness), and thickness, and was excellent also in chemical resistance again, for example, urethane foam, a nonwoven fabric, artificial leather, etc. is used, and non-illustrated abrasive cloth is stuck on a turn table.

[0026] This example is constituted in this way, is a predetermined location and makes a semi-conductor substrate stick to outside-surface 3c of the plate 3 for substrate adsorption. Since an adsorption hole is in the location comparatively near guide 3a for substrate immobilization in this condition, the semi-conductor substrate is curving with a certain amount of curvature along with outside-surface 3c. And this is conveyed, and it presses by the predetermined processing pressure force to the abrasive cloth stuck on the turn table, and the bulb of a vacuum pump is closed, and a vacuum pump is suspended. Then, since a semi-conductor substrate is pushed back from abrasive cloth, a semi-conductor substrate curves along with outside-surface 3c. In addition, since the both sides of the force pushed back from abrasive cloth and the force in which it returns this by the elastic force of the semi-conductor substrate itself work, it is not necessary to necessarily stick the edge of a semi-conductor substrate to outside-surface 3c. In addition, since the bulb of a vacuum pump is closed, and the vacua of an adsorption hole is maintained, therefore the curve force of a semi-conductor substrate has arisen also by adsorption from an adsorption hole, a semi-conductor substrate is pushed back from abrasive cloth, and the curve side configuration is formed of the force of the both sides of the force and the suction force from an adsorption hole. Thus, if a semi-conductor substrate curves, and the pressure distribution within a substrate side become more uniform, therefore it grinds in this condition, the amount distribution of polishes within a more uniform substrate side will be acquired by Preston style;(dT/dt) =kxPx (ds/dt).

[0027] When a semi-conductor substrate is made into a curve side configuration, the core (Center) and periphery (Edge) of a substrate explain an experiment of [rate / polish removal] based on drawing 3 and drawing 4 . Using the 5 inch substrate, the outside surface of the semi-conductor substrate attachment section was made into the radii configuration, and the amount of displacement was given to the core and periphery so that the core might serve as a convex configuration to a periphery. Polish conditions are the processing pressure force 493 g/cm2 It carried out, and H-1 (Rodel Nitta make) was used for abrasive cloth, and 30rpm and the rotation carrier rotational frequency for polish were set to 30rpm for polish rotating speed. And like the 1st example, it curved and the semi-conductor was ground. When not incurvating a semi-conductor substrate by drawing 3 (location of an axis of abscissa 0), the polish removal rate of the periphery of a semi-conductor substrate is quite larger than that of a core. When the variation rate of about 18 micrometers is given between the core of an outside surface, and a periphery, the difference of a polish removal rate

becomes small. When the difference of a polish removal rate becomes still smaller when the variation rate of about 30 micrometers is given between the core of an outside surface, and a periphery, and the variation rate of about 50 micrometers is given between the core of an outside surface, and a periphery, the removal rate of the core of a semi-conductor substrate is larger than the removal rate of a periphery conversely. From these, the relation shown in the straight line of drawing 3 is obtained, and when the variation rate of about 34 micrometers is given between the core of an outside surface, and a periphery, the polish removal rate of the core of a semi-conductor substrate and a periphery is expected to be mostly in agreement. Drawing 4 is the graph which carried out the difference of these removal rates comparatively, and showed it. The axis of ordinate is expressed with the numeric value of [(minimum value of the maximum-removal rate of a removal rate) / (average of 2x removal rate)].

[0028] Next, the 2nd example of this invention is explained. In drawing 5 , the interior of contact of the rotation carrier 12 for polish attached in the carrier support shaft 11, and the plate 13 for substrate adsorption attached in this Covered shaft orientations to those both sides, and were extended in the direction of a path even in the location of guide 13a for substrate immobilization. The space section 14 is formed, semi-conductor substrate attachment section 13b is formed in predetermined thickness so that it can curve, and outside-surface 13c is formed in the flush side in the condition of not driving the width-of-face adjustable material 15 mentioned later. and the extension sections 12d and 13d of the predetermined cross section which the rotation carrier 12 for polish and the plate 13 for substrate adsorption approach mutually in a center section -- having -- between extension sections [12d and 13d] apical surfaces -- the width of face of the width-of-face adjustable material 15 -- abbreviation -- it is the gap section 16 of equal width of face.

[0029] Since it is desirable for semi-conductor substrate attachment section 13b to maintain a curve configuration, and to reproduce the same curve side configuration by the same drive of the width-of-face adjustable material 15, it has sufficient elasticity and to be the quality of the material which does not cause plastic deformation easily is desired. Moreover, since curved semi-conductor substrate attachment section 13b is supported in the location of the width-of-face adjustable material 15, and receives the processing pressure force and this processing pressure force gets across to semi-conductor substrate attachment section 13b, semi-conductor substrate attachment section 13b is wanted to be the material which can fully bear shearing stress. Furthermore, since it dislikes mixing of a metal impurity extremely in order to secure the dependability of a semiconductor device, when the metal component is included as the quality of the material of semi-conductor substrate attachment section 13b, it is desirable [a semiconductor device manufacture process] to form the screen of a metal impurity in the contact section with a semi-conductor substrate. Therefore, especially semi-conductor substrate attachment section 13b is formed by stainless steel or phosphor bronze, and, as for outside-surface 13c, it is desirable that the Teflon coat is carried out. Teflon means polytetrafluoroethylene here. In addition, semi-conductor substrate attachment section 13b is rich in pressure resistance nature, and as long as it is the elastic quality of the material, it may use plastics. In addition, semi-conductor substrate attachment section 13b may be formed in plate 13 body for substrate adsorption, and one, and is manufactured separately, and may be fixed to plate 13 body for substrate adsorption (illustration abbreviation). next, the adsorption hole 18 is comparatively looked like [guide 13a for substrate immobilization], and is prepared at semi-conductor substrate attachment section 13b and the same axle on [eight] the periphery of the diameter of predetermined of a near location (for example, two thirds of paths of the path of a semi-conductor substrate). And it connects with a non-illustrated tube within the space section 14, and connects with a non-illustrated vacuum pump further, and the adsorption hole 18 inhales the open air from an adsorption hole by driving this. A semi-conductor substrate is attracted by outside-surface 13c with this suction force, and it is handled and conveyed. The configuration is determined so that it may push back from adsorption power and abrasive cloth like the 1st example and, as for curve side configuration 13c of an outside surface, the configuration of a semi-conductor substrate may turn into a predetermined curve side configuration with more uniform thrust according to the force.

[0030] The width-of-face adjustable material 15 is attached in the gap section 16. In the width-of-face adjustable material 15, controlling force, such as electric force and magnetism, is made to act, and it is the thing of the material in which adjustable is possible about the width of face, for example,

a piezo-electric element, a giant magnetostrictive alloy, etc. are used. If the width-of-face adjustable material 15 is made to drive according to controlling force, since the width of face of the width-of-face adjustable material 15 tends to become large, tends to contact an extension sections [12d and 13d] apical surface and tends to extend for 12d of extension sections, and 13d, semi-conductor substrate attachment section 13b, i.e., the outside-surface 13c, becomes a curve side configuration.
[0031] Next, the relation between polish conditions, such as a class of abrasive cloth, processing pressure force, and thickness, a class of a semi-conductor substrate, and the width of face of the width-of-face adjustable material with which the pressure distribution then searched for are acquired is created as table data.
[0032] Thus, after pressing the rear stirrup made to adsorb to abrasive cloth, it defines the setting width of face of a width-of-face adjustable material, and makes controlling force act based on table data according to polish conditions, such as a class of abrasive cloth, processing pressure force, and thickness, a class of a semi-conductor substrate, so that it may become this width of face before constituting and making a semi-conductor substrate stick to an outside surface. Then, in the condition of having pressed the semi-conductor substrate to abrasive cloth, like the 1st example, it pushes back from adsorption power and abrasive cloth, and a predetermined curve side configuration is formed in a semi-conductor substrate of the force, and it grinds in this condition according to it. Thereby, the semi-conductor substrate of the uniform amount distribution of polishes made into the purpose is obtained. Next, when polish conditions change, the width of face of the width-of-face adjustable material 15 is changed with table data, and this grinds.
[0033] In addition, since semi-conductor substrate attachment section 13b was formed by stainless steel or phosphor bronze, a predetermined curve side configuration is maintained and repeat repeatability is secured. Moreover, since the Teflon coat of the outside-surface 13c is carried out, mixing of the metal impurity to the semi-conductor substrate by which outside-surface 13c is adsorbed in use of this polish equipment is prevented greatly.
[0034] In this example, the number and location of a width-of-face adjustable material can be set up so that the curve side configuration of an outside surface may become the optimal. For example, drawing 6 forms eight width-of-face adjustable materials 25 in the core of semi-conductor substrate attachment section 23b at equal intervals in the shape of a periphery in the location of abbreviation middle of the core of one piece and semi-conductor attachment section 23b, and an edge. And the curve side configuration of optimal outside-surface 23c which had curvature desirable enough also in near [of abbreviation middle] the location of a core and an edge can be acquired by making into width of face smaller than the setting width of face of the width-of-face adjustable material 25 of a core setting width of face of eight width-of-face adjustable materials 25 arranged in the location of abbreviation middle of a core and an edge.
[0035] Next, the 3rd example of this invention is explained. In drawing 1 , the space section 34 which was extended on elongation even on the production of 33d of inner end faces of guide 33a for substrate immobilization, and was extended even near the outside-surface 33c to shaft orientations in the direction of a path is formed in the plate 33 for substrate adsorption. and the inside of the space section 34 -- to the core, respectively six pieces and eight width-of-face adjustable materials 35 fix in the shape of a periphery in each location of about 3 division into equal parts of the distance between the core of one piece and semi-conductor substrate attachment section 33b, and an edge, fix on the rotation carrier 32 for polish at equal intervals, and it arranges. And the hard ball 37 is arranged between the core of the apical surface of each width-of-face adjustable material 35, and semi-conductor substrate attachment section 33b. You may fix for the width-of-face adjustable material 35, and the hard ball 37 may be fixed to semi-conductor substrate attachment section 33b. A hard ball 37 may be arranged to each hole of one cage (illustration abbreviation) which may fix to both sides and has been arranged in the space section 34, and a hard ball 37 may be held, without fixing to neither the width-of-face adjustable material 35 nor semi-conductor substrate attachment section 33b. The hard quality of the material is used for a hard ball 37, for example, metal balls, such as steel, etc. are used.
[0036] Next, on the outside of guide 33a for substrate immobilization, all peripheries are covered to the location on extension of outer edge surface 33e of guide 33a for substrate immobilization, 33f of notches is formed, and it has the composition that semi-conductor substrate attachment section 33b

of predetermined thickness was extended to the outside of guide 33a for substrate immobilization while [the] it had been thick.
[0037] Since other configurations are the same as that of the 2nd example, explanation is omitted.
[0038] If this example is constituted in this way and the width-of-face adjustable material 35 is driven, each width-of-face adjustable material will produce expansion of the width of face according to the controlling force, and will make outside-surface 33c of semi-conductor substrate attachment section 33b a predetermined curve side configuration. Since the width-of-face adjustable material 35 is arranged besides the core also on each periphery of about 3 division into equal parts of the path of substrate attachment section 33b, outside-surface 33c which had curvature desirable enough also in these parts is obtained. Moreover, in contacting the flush apical surface of the width-of-face adjustable material 35 to direct substrate attachment section 33b, substrate attachment section 33b becomes a flush side in the part of the flush apical surface of the width-of-face adjustable material 35. Although there is a possibility of sudden change of a curve arising in the place which becomes this flush side from the curve side of outside-surface 33c, therefore distortion being possible for pressure distribution and producing polish unevenness In this example, since expansion of the width of face of the width-of-face adjustable material 35 is told to substrate attachment section 33b by point contact through a shot 37, the pressure distribution which the above-mentioned problem does not arise and do not have distortion are acquired. Furthermore, if the rigidity of the part of the substrate attachment section 33b outside of the plate 33 for substrate adsorption is high when substrate attachment section 33b curves Although substrate attachment section 33b cannot fully curve in the edge ring-like part of substrate attachment section 33b, namely, it becomes a flush side in this ring-like part and the pressure distribution of this part become large Since 33f of notches is prepared, when 33f of notches narrows, by making it into the supporting point near the substrate fixed guide 33a, also in the edge ring-like part of substrate attachment section 33b, it fully rotates and sufficient curve of this part is attained. In addition, although the amount of supply of the abrasive material which will go to a substrate core if a pressure is high decreases in the above-mentioned ring-like part and it becomes the cause of a fall of the polish removal rate of a substrate core, it becomes possible by preparing the 33f of the above-mentioned notches to fully supply an abrasive material to a substrate core.
[0039] In the above-mentioned example although the curve of a semi-conductor substrate is pushed back from the adsorption power and abrasive cloth from an adsorption hole and the force of the both sides of the force performs it, the curve of a semi-conductor substrate may be pushed back from abrasive cloth, and only the force may perform it.
[0040] This invention can be used also when grinding by changing the polishing pressure force of a semi-conductor substrate in each part within a field. Namely, when the film of predetermined thickness is formed in the front face of a semi-conductor substrate and heterogeneity is in that thickness for example, make it correspond to this heterogeneity, incurvate the outside surface of the semi-conductor substrate attachment section in a predetermined configuration, and this is contacted in a semi-conductor substrate. If thrust with abrasive cloth can be made greatly and small in the thick place of thickness, and a thin place, respectively if a semi-conductor substrate is incurvated, therefore this grinds More parts of thick thickness can be ground, and the part of thin thickness can be ground fewer, therefore residual film thickness can be made more nearly equal. Thus, this invention is applicable to highly precise control of the polishing pressure force within the field of a semi-conductor substrate.
[0041]
[Effect of the Invention] Since this invention was constituted as mentioned above, it becomes possible to be able to control polishing pressure force distribution to high degree of accuracy more, therefore to control the amount of polishes with high precision in polish processing of a semi-conductor substrate.

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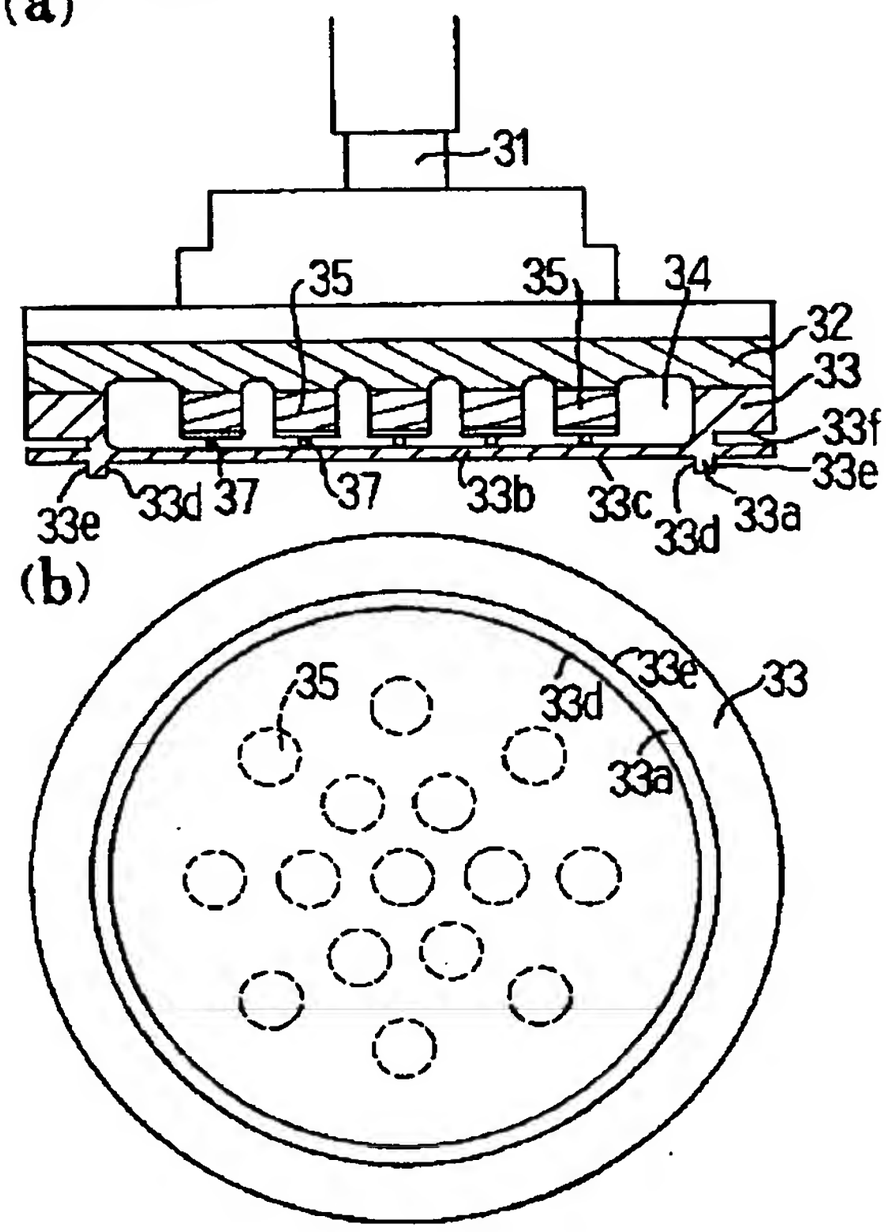
3.In the drawings, any words are not translated.

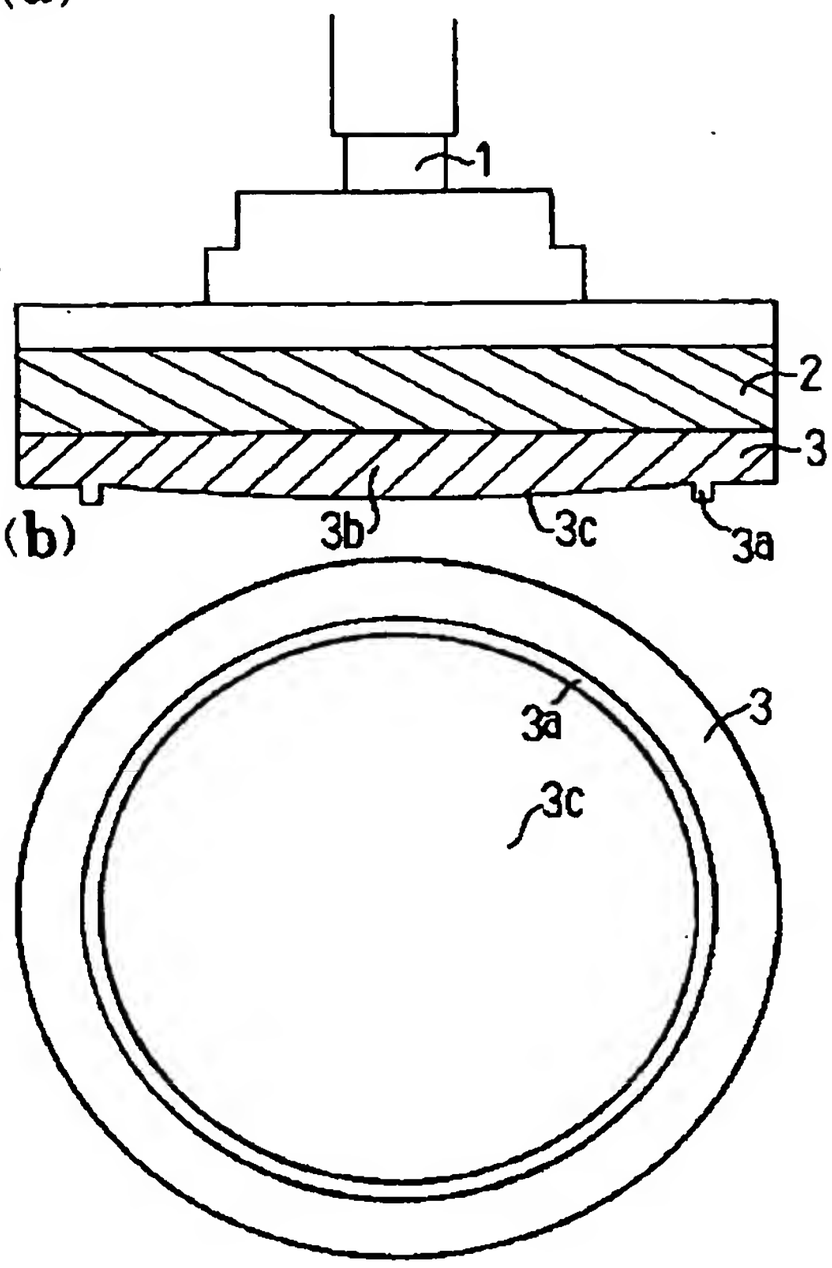
DRAWINGS

[Drawing 1]



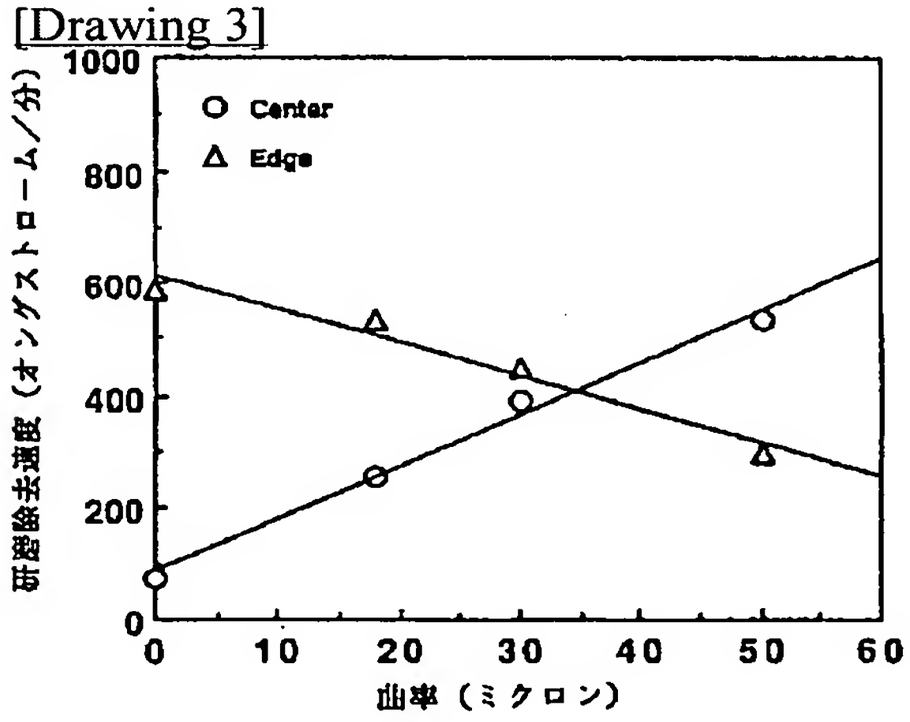
[Drawing 2]

(a)

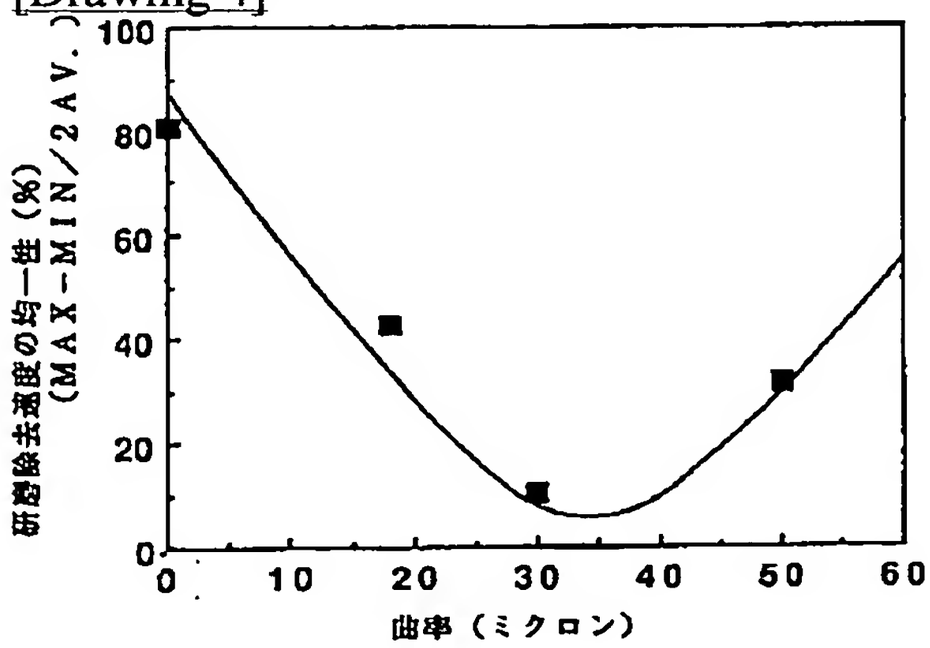


(b)

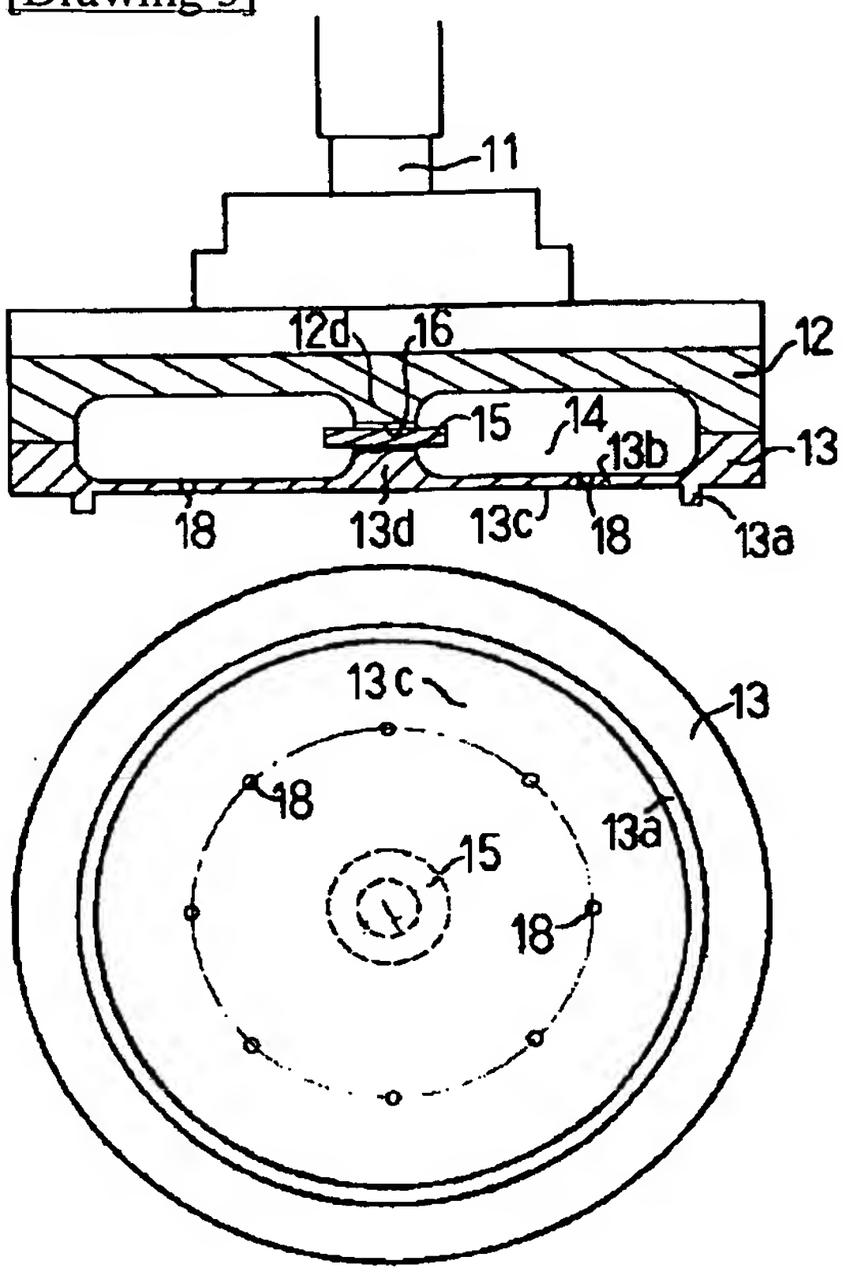
[Drawing 3]



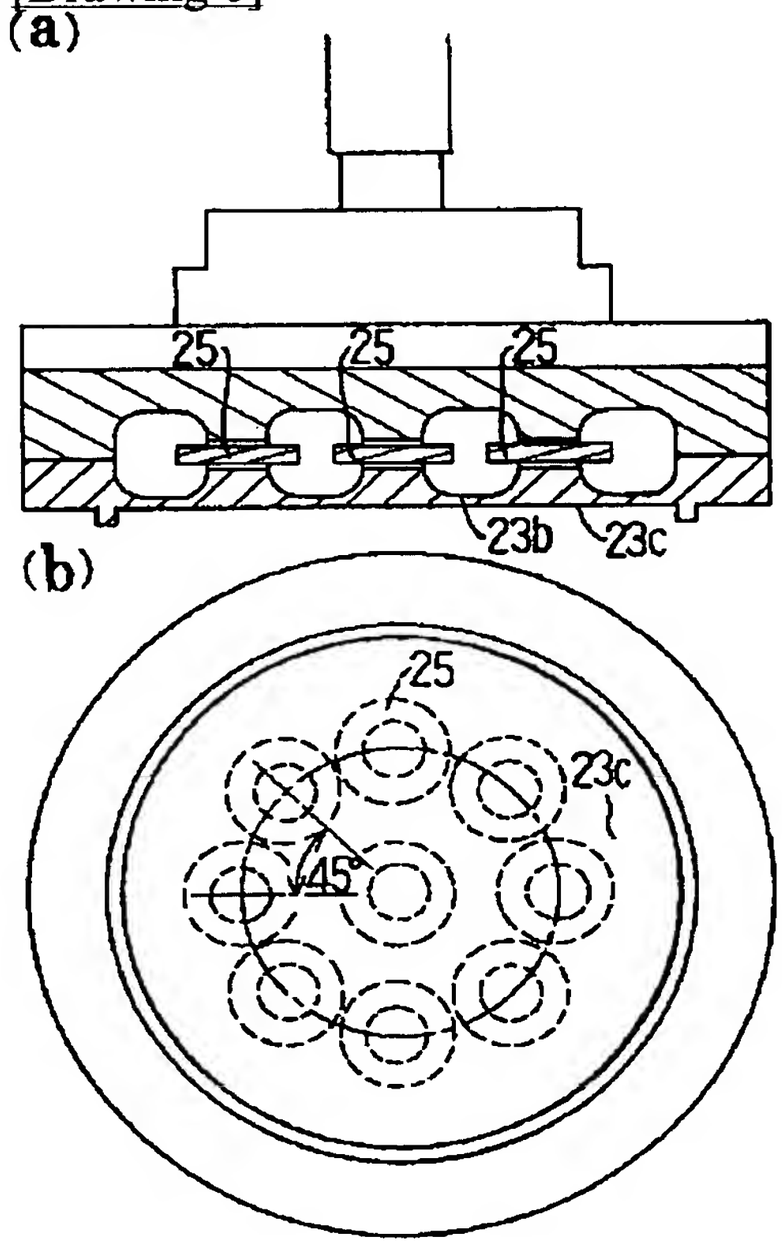
[Drawing 4]



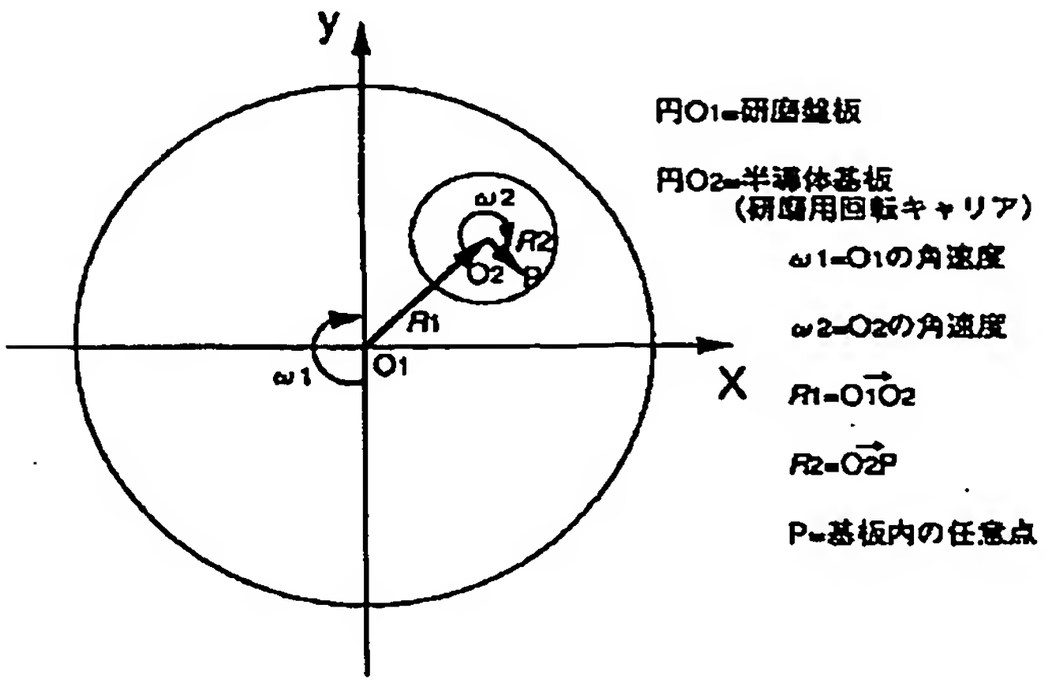
[Drawing 5]



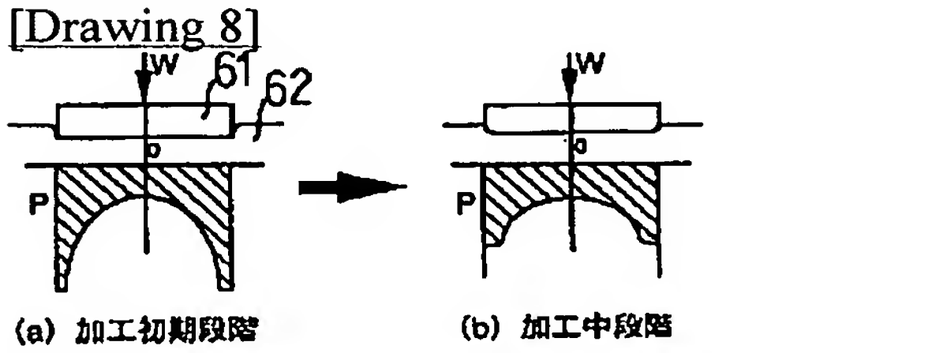
[Drawing 6]

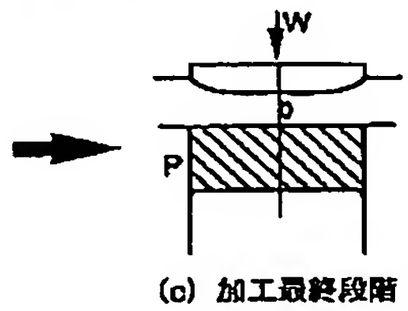


[Drawing 7]



[Drawing 8]





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PATENT ABSTRACTS OF JAPAN

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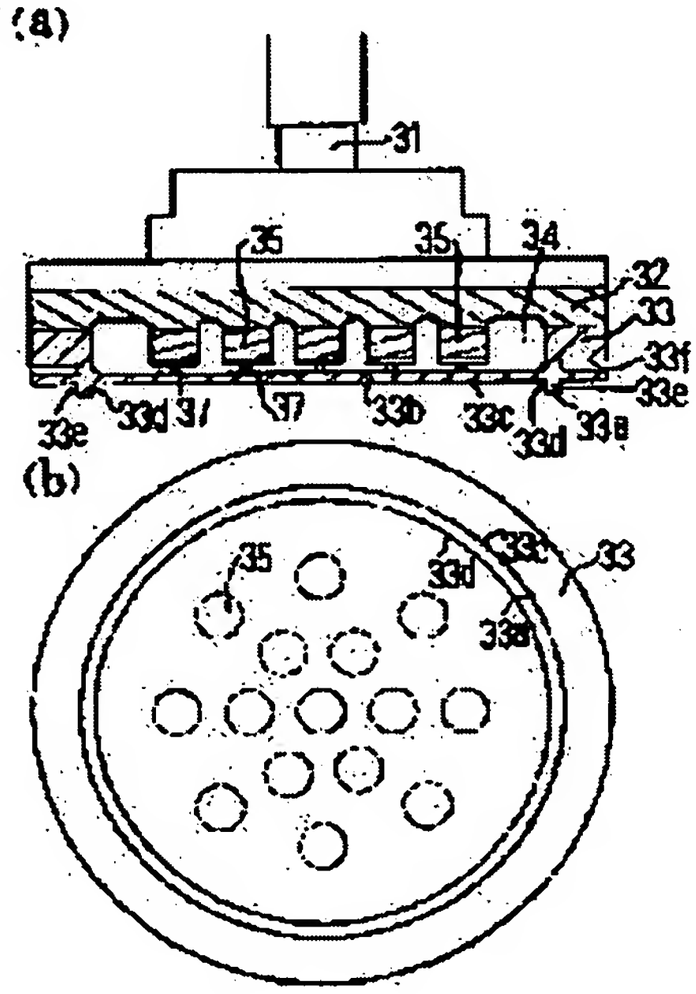
(21)Application number : 05-300938
(22)Date of filing : 06.11.1993

(71)Applicant : SONY CORP
(72)Inventor : HAYAKAWA HIDEAKI
KIMURA KEIICHI

(54) GRINDING DEVICE OF SEMICONDUCTOR SUBSTRATE

(57)Abstract:
PURPOSE: To secure uniformity within a semiconductor substrate of a grinding amount in a single-leaf type grinding device of semiconductor substrate (wafer).
CONSTITUTION: An outer surface 33c (a contact surface of a semiconductor substrate) of a substrate mounting part 33b is outwardly swollen to be a curve surface shape. Further, this is attached to the semiconductor substrate pressed against abrasive cloth and the semiconductor substrate is bent along the outer surface 33c by an elastic force of abrasive cloth. Thus, it is possible to make uniformer a surface inside distribution of conventional process pressure, particularly the surface inside distribution in which elasticity of the abrasive cloth acts largely on a peripheral part of the semiconductor substrate to elevate process pressure of the part. The uniformity inside the surface of a grinding amount is secured more. A curve surface shape is formed, as shown in Fig. 1, by driving a piezo-element, a super-magnetostrictive alloy, etc., 35. Also, it may be fixedly formed.



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(22)出願日　平成５年(1993)11月６日

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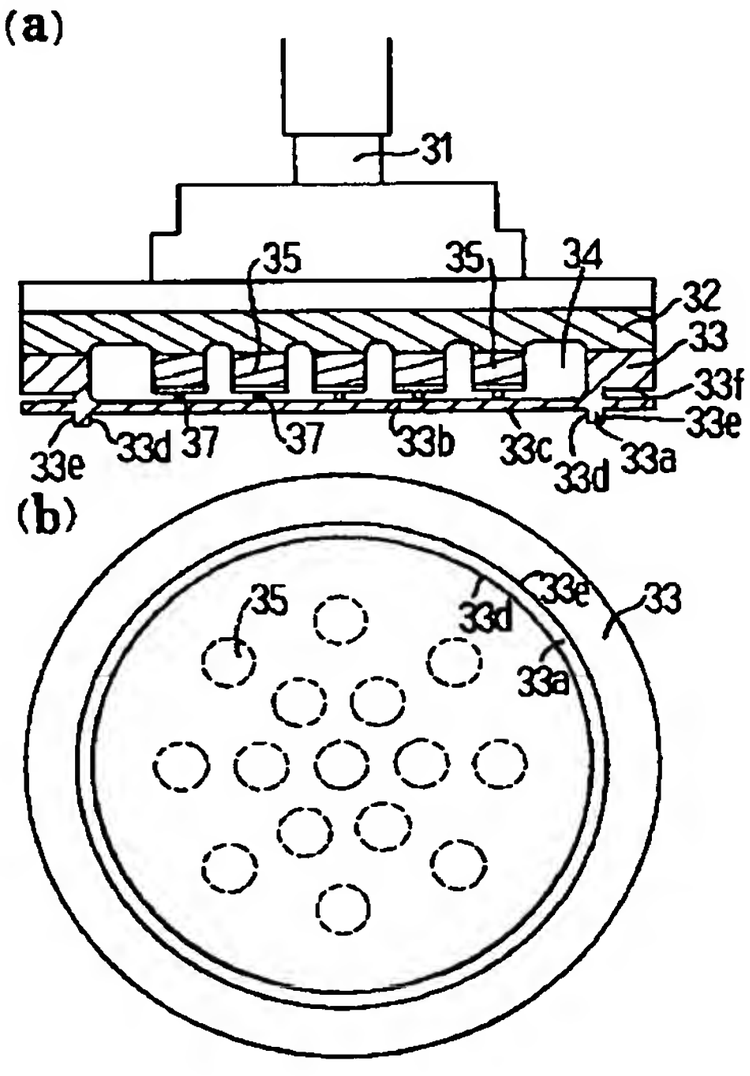
(54)【発明の名称】半導体基板の研磨装置

(57)【要約】
【目的】　枚葉式の半導体基板（ウェーハ）の研磨装置において、研磨量の半導体基板面内の均一性を確保する。
【構成】　基板取付部３３ｂの外表面３３ｃ（半導体基板の当接面）を外方へ膨らんだ湾曲面形状にする。またこれに半導体基板を取り付けて研磨布に押圧して、研磨布の弾性力により半導体基板を外表面３３ｃに沿って湾曲する。これにより、従来加工圧力の面内分布，特に研磨布の弾性が半導体基板の周辺部に大きく作用してその部分の加工圧力が高くなっていた面内分布を、より均一にすることができ、研磨量の面内の均一性がより確保される。湾曲面形状は図１に示すようにピエゾ素子，超磁歪合金等３５を駆動して形成してもよく、また、固定的に形成してあってもよい（図示省略）。



【特許請求の範囲】

【請求項１】　研磨用回転キャリアに取り付けられた基板吸着用プレートの半導体基板取付部に取り付けられた半導体基板を、研磨布を介在させて、研磨定盤に対向させ、上記半導体基板の表面を上記研磨布により研磨する半導体基板の研磨装置において、
上記基板吸着用プレートの半導体基板取付部の外表面は外方に膨らんだ湾曲面形状であることを特徴とする半導体基板の研磨装置。

【請求項２】　請求項１において、上記半導体基板の上記半導体基板取付部の外表面に沿った湾曲は、上記半導体基板を上記研磨布に押圧してなされることを特徴とする半導体基板の研磨装置。

【請求項３】　請求項１又は請求項２において、上記研磨用回転キャリアと上記基板吸着用プレートとの間に又は上記基板吸着用プレート内にピエゾ素子，超磁歪合金等の幅可変素材が介在しており、上記幅可変素材に上記半導体基板取付部が対向しており、上記幅可変素材を駆動して上記半導体基板取付部の外表面の湾曲面形状を変化可能であることを特徴とする半導体基板の研磨装置。

【請求項４】　請求項３において、上記幅可変素材と上記半導体基板取付部との間に硬球が介在していることを特徴とする半導体基板の研磨装置。

【請求項５】　請求項３又は請求項４において、上記基板吸着用プレートは上記半導体基板取付部の外側位置において、上記半導体基板取付部の外側位置の剛性を低減するための切欠部が円周方向に形成されていることを特徴とする半導体基板の研磨装置。

【請求項６】　請求項３～請求項５のいずれか１つにおいて、上記半導体基板取付部はステンレス鋼又はリン青銅で形成されており、かつ上記半導体基板取付部の外表面はテフロンコートされていることを特徴とする半導体基板の研磨装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】この発明は、研磨用回転キャリアに取り付けられた基板吸着用プレートの半導体基板取付部に取り付けられた半導体基板（ウェーハ）を、研磨布を介在させて、研磨定盤に対向させ、半導体基板の表面を研磨布により研磨する半導体基板の研磨装置に関するものである。

【０００２】

【従来の技術】ＵＬＳＩの高集積化が進むにつれ、微細パターンを加工する上でチップ内のデバイス段差を低減する要求が益々高まっている。特に、積層配線構造を必須としているロジックＩＣでは、これが深刻な問題となっている。この問題を解決するためにグローバル平担化の検討が行われてきている。

【０００３】そして、グローバル平担化を達成できる技術として、特に、化学機械研磨（Ｃｈｅｍｉｃａｌ－Ｍｅｃａｎｉｃａｌ－Ｐｏｌｉｓｈｉｎｇ，以下、ＣＭＰと略す）法が注目を浴びている。

【０００４】そして、ＣＭＰ法において、ＲＩＥやＰＶＤ等のプロセスマージンをより広げ、フォトリソのアライメントマークの検出をより容易に行う必要から、同一半導体基板の面内における、或いは半導体基板同士の間における、研磨量（研磨除去速度）の均一性向上が重要なテーマとなっている。

【０００５】ここに、ＣＭＰ法の研磨量は一般的にプレストン（Ｐｒｅｓｔｏｎ）式；（ｄＴ／ｄｔ）＝ｋ×Ｐ×（ｄｓ／ｄｔ）で表すことができる。ここに、Ｔ：膜厚，ｋ：比例定数，Ｐ：加工圧力，ｓ：基板内任意点の変位量（移動量），ｔ：時間である。ｋは被研磨材質と、研磨剤及び研磨布によって決まる定数である。また、基板内のｄｓ／ｄｔの分布は、研磨定盤と研磨用回転キャリアの角速度を等しくすることで均一化することができる。即ち、図７に示す、枚葉式の一軸系の研磨装置において、研磨円盤（円Ｏ１）の中心を原点としてＸ，Ｙ軸をとり、研磨円盤の角速度をω１，研磨用回転キャリアとともに回転する半導体基板（円Ｏ２）の角速度をω２とすると、半導体基板上の任意点Ｐの速度ｕは
ｕ＝（Ｒ１＋Ｒ２）ω１－Ｒ２ω２＝（ω１－ω２）Ｒ２＋ω１Ｒ１となる。ここでＲ１は研磨円盤（円Ｏ１）の中心と半導体基板（円Ｏ２）の中心との間の距離ベクトル，Ｒ２は半導体基板（円Ｏ２）の中心と任意点Ｐとの間の距離ベクトルである。従ってω１＝ω２のときｕ＝ω１Ｒ１となり、Ｒ２に依存せず、ω１とＲ１のみの関数となるためω１とＲ１を固定させれば、ｕは基板内で一定のベクトル量を持つことになる。即ち速度分布がなくなる。

【０００６】従って、プレストン式において、ｋ及び（ｄｓ／ｄｔ）は基板内で均一化できるため、研磨量を均一にするためには、研磨圧力Ｐの面内分布を均一にすることが重要になる。

【０００７】

【発明が解決しようとする課題】しかしながら、半導体基板には研磨定盤に貼り付けられた研磨布が当接するために、研磨布の半導体基板に対する押圧力は、どうしても半導体基板の周辺部でより大きくなるという問題がある（参照；ＣＭＰセミナーテキスト１９９３年２月２３，２４日号７１～８５頁：土肥俊郎著，主催（株）リアライズ社）。即ち、図８（ａ）に示すように、通常の研磨では、基板吸着用プレートはできる限り平担面に近付けているため、これに吸着される半導体基板６１も平担面となり、この平板状態の半導体基板６１に研磨布６２が当接し、所定の加工圧力Ｗが作用すると、研磨布６２の弾性変形に伴い、圧力Ｐが基板周辺に集中する。従ってこの状態で研磨すると研磨量（研磨除去速度）も基板周辺が大きく（同図（ｂ））、最終的には、圧力分布がより均一になる基板形状状態で、研磨加工が終了する

（同図（ｃ））。

【０００８】上記の研磨布の弾性変形に伴う圧力の基板周辺への集中の問題は、基板吸着用プレートの平担度，研磨定盤の平担度，研磨布の厚みむら，回転時の研磨定盤の面ぶれ等の研磨装置，研磨布等の製作精度に伴う加工圧力Ｐの不均一性の問題等，製作精度の向上により十分に解決可能な問題と異なり、研磨機構が本来有する構造上の問題であるので、研磨精度を十分に向上させるためには、その構造上の欠陥を十分に解消することが極めて重要である。

【０００９】そこで本発明の目的は、上記の構造上の欠陥を十分に解消して、研磨布の半導体基板に対する押圧力の均一性を確保し、以て研磨量の均一性を得ることが可能な半導体基板の研磨装置を提供することにある。

【００１０】

【課題を解決するための手段】上記目的を達成するために、本発明は、研磨用回転キャリアに取り付けられた基板吸着用プレートの半導体基板取付部に取り付けられた半導体基板を、研磨布を介在させて、研磨定盤に対向させ、半導体基板の表面を研磨布により研磨する半導体基板の研磨装置において、基板吸着用プレートの半導体基板取付部の外表面は外方に膨らんだ湾曲面形状である。

【００１１】半導体基板の半導体基板取付部の外表面に沿った湾曲は、半導体基板を研磨布に押圧してなされてもよい。

【００１２】研磨用回転キャリアと基板吸着用プレートとの間に又は基板吸着用プレート内にピエゾ素子，超磁歪合金等の幅可変素材が介在しており、幅可変素材に半導体基板取付部が対向しており、幅可変素材を駆動して半導体基板取付部の外表面の湾曲面形状を変化可能であってもよい。

【００１３】幅可変素材と半導体基板取付部との間に硬球が介在していてもよい。

【００１４】幅可変素材を駆動して半導体基板取付部の外表面の湾曲面形状を変化可能である場合に、基板吸着用プレートは半導体基板取付部の外側位置において、半導体基板取付部の外側位置の剛性を低減するための切欠部が円周方向に形成されていてもよい。

【００１５】幅可変素材を駆動して半導体基板取付部の外表面の湾曲面形状を変化可能である場合に、半導体基板取付部はステンレス鋼又はリン青銅で形成されており、かつ半導体基板取付部の外表面はテフロンコートされていてもよい。

【００１６】

【作用】研磨除去速度はプレストン式から研磨圧力が等しいとき、均一にすることができる。従って予め半導体基板を湾曲させて、研磨布を押圧したときの圧力分布がより均一となるようにして研磨を行えば、より均一な基板面内の研磨量分布が得られる。そして研磨終了後、半導体基板の湾曲を元の平板状態に戻せば、最終的により

均一な研磨量分布を有する平板状の半導体基板が得られる。ところで、半導体基板は基板吸着用プレートの半導体基板取付部の外表面に取り付けられるので、この外表面を予め湾曲面とし、半導体基板をこれに沿って湾曲させれば、半導体基板を湾曲させることができる。

【００１７】半導体基板を半導体基板取付部の外表面に取付けた後、半導体基板を研磨布に押圧すると、研磨布は所定の厚みを有しかつ所定の弾性を有しているので、半導体基板は、研磨布に押し返されて、半導体基板取付部の外表面に沿って湾曲する。従って別段の半導体基板を外表面に沿って湾曲させる手段を設けなくとも、これにより、半導体基板を湾曲させることができる。

【００１８】研磨布の厚み、弾性率や加工圧力の大小等により圧力分布が面内で均一になる半導体湾曲面形状が異なる。従って半導体基板取付部の外表面の湾曲面形状を可変できることが望ましい。研磨用回転キャリアと基板吸着用プレートとの間に又は基板吸着用プレート内にピエゾ素子，超磁歪合金等の幅可変素材を介在させ、これを駆動して、これに対向する半導体基板取付部を変位させることにより、半導体基板取付部の外表面の湾曲面形状を任意に変えることができる。

【００１９】幅可変素材と半導体基板取付部との間に硬球が介在していると、幅可変素材は半導体基板取付部に、面としてではなく点として、変位力を与えるので、半導体基板取付部の外表面に、より歪みのない滑らかな湾曲面形状を与えることができる。

【００２０】幅可変素材により半導体基板取付部を湾曲させる場合に、基板吸着用プレートの半導体基板取付部の外側位置にこの部分の剛性を低減する切欠部を形成することにより、半導体基板取付部の端部付近の湾曲を十分に得ることができる。

【００２１】幅可変素材により半導体基板取付部を湾曲させる場合には、半導体基板取付部をステンレス鋼又はリン青銅とすることにより、塑性変形が防止され、また、剪断応力に十分に耐えることができるので、所望の湾曲面を維持し、かつ繰り返して、その湾曲面を作ることが可能になる。また、外表面にテフロンコートしてあることにより、半導体基板への金属不純物の混入が防止される。

【００２２】

【実施例】以下、本発明の実施例を図面に基づいて詳細に説明する。まず、本発明の第１実施例について説明する。本実施例は枚葉式の一軸系の研磨装置の例であり、図２において、キャリア支持軸１に研磨用回転キャリア２が取り付けられている。本実施例において、キャリア支持軸１は後述の研磨定盤と等しい角速度で回転するよう、構成される。

【００２３】そして研磨用回転キャリア２には、基板吸着用プレート３が取り付けられている。基板吸着用プレート３には、外周部に、基板固定用ガイド３ａが設けて

5

ある。基板固定用ガイド３ａの内側が半導体基板取付部３ｂとなる。基板固定用ガイド３ａは研磨中に半導体基板が半導体基板取付部３ｂから抜け出ることを防止する。半導体基板取付部３ｂの外表面３ｃは半導体基板の取付面であり、外方に膨らんだ湾曲面形状になっている。半導体基板取付部３ｂには不図示の吸着孔が設けてある。吸着孔は半導体基板取付部３ｂと同軸に、基板固定用ガイド３ａに比較的に近い位置の所定径（例えば半導体基板の径の２／３の径）の円周上に例えば８個設けてある（図５参照）。吸着孔の後方には不図示の真空ポンプが接続され、これを駆動することにより吸着孔から外気を吸い込む。この吸引力により半導体基板は外表面３ｃに吸い付けられてハンドリング，搬送される。外表面の湾曲面形状３ｃは、後述するように半導体基板を研磨布に押圧したときに、吸着孔による吸引力とも相俟って、半導体基板の形状が押圧力がより均一な所定の湾曲面形状になるように、その形状が決定される。また、湾曲面形状３ｃは、半導体基板の厚さや、研磨布の厚み、弾性率や加工圧力の大小等の研磨条件により複数種類、用意される。半導体基板取付部３ｂは基板吸着用プレート３と一体になっており、化学的に侵されず、荷重に対して変形の少ない材質，例えばセラミック，ガラス等の材質により、製作される。なお、耐圧力性に優れかつ耐久性に富んだものであればプラスチックであってもよい。

【００２４】次に、不図示の研磨定盤は円板状に形成されており、ステンレス鋼，セラミックス等の化学的に侵されない材質で形成してある。

【００２５】次に、不図示の研磨布は、一定の研磨能力を持ち、一定の摩擦抵抗，適度の弾性率（硬さ），厚さがありまた、耐薬品性にも優れた材質、例えば発泡ウレタン，不織布，人工皮革等の材質が用いられ、研磨定盤に貼り付けられる。

【００２６】本実施例はこのように構成してあり、所定位置で、基板吸着用プレート３の外表面３ｃに半導体基板を吸着させる。この状態で、吸着孔は基板固定用ガイド３ａに比較的近い位置にあるので、半導体基板は外表面３ｃに沿ってある程度の曲率で湾曲している。そしてこれを搬送して、研磨定盤に貼り付けられた研磨布に所定の加工圧力で押圧し、かつ真空ポンプのバルブを閉じ、真空ポンプを停止する。すると、半導体基板は研磨布から押し返されるので、半導体基板が外表面３ｃに沿って湾曲する。なお、半導体基板の端部は、研磨布から押し返される力と半導体基板自体の弾性力によるこれを戻そうとする力の双方が働くので、必ずしも外表面３ｃに密着しなくてもよい。なお、真空ポンプのバルブを閉じて吸着孔の真空状態を維持しており、従って吸着孔からの吸着によっても半導体基板の湾曲力が生じているので、半導体基板は研磨布からの押し返し力及び吸着孔からの吸引力の双方の力により、その湾曲面形状が形成されている。このようにして半導体基板が湾曲され、基板面内の圧力分布がより均一となり、従ってこの状態で研磨すると、プレストン式；（ｄＴ／ｄｔ）＝ｋ×Ｐ×（ｄｓ／ｄｔ）により、より均一な基板面内の研磨量分布が得られる。

【００２７】半導体基板を湾曲面形状としたときに研磨除去速度を基板の中心部（Ｃｅｎｔｅｒ）と周辺部（Ｅｄｇｅ）とで比較した実験を図３，図４に基づいて説明する。５インチ基板を用い、その中心部が周辺部に対して凸形状となるように、半導体基板取付部の外表面を円弧形状にし、その中心部と周辺部とに変位量を与えた。研磨条件は、加工圧力を４９３ｇ／ｃｍ2 とし、研磨布にＨ－１（Ｒｏｄｅｌニッタ社製）を用い、研磨定盤回転数を３０ｒｐｍ，研磨用回転キャリア回転数を３０ｒｐｍとした。そして第１実施例と同様にして半導体を湾曲して研磨した。図３により、半導体基板を湾曲させないとき（横軸０の位置）には、半導体基板の周辺部の研磨除去速度が中心部のそれよりかなり大きくなっている。外表面の中心部と周辺部との間に約１８μｍの変位を与えたときには研磨除去速度の差が小さくなり、外表面の中心部と周辺部との間に約３０μｍの変位を与えたときには研磨除去速度の差が更に小さくなり、外表面の中心部と周辺部との間に約５０μｍの変位を与えたときには、逆に半導体基板の中心部の除去速度が周辺部の除去速度よりも大きくなっている。これらより、図３の直線で示す関係が得られ、外表面の中心部と周辺部との間に約３４μｍの変位を与えたときに半導体基板の中心部と周辺部との研磨除去速度がほぼ一致すると予想される。図４はこれらの除去速度の差を割合として示したグラフである。縦軸は、［（除去速度の最大値－除去速度の最小値）／（２×除去速度の平均値）］の数値で表してある。

【００２８】次に本発明の第２実施例を説明する。図５において、キャリア支持軸１１に取り付けられた研磨用回転キャリア１２と、これに取り付けられている基板吸着用プレート１３との当接内部は、軸方向にそれらの双方に亘って、かつ、径方向に基板固定用ガイド１３ａの位置にまで伸びた、空間部１４が形成されており、半導体基板取付部１３ｂは湾曲可能なように所定の肉厚に形成され、外表面１３ｃは後述する幅可変素材１５を駆動しない状態で平担面に形成してある。そして、中央部において、研磨用回転キャリア１２と基板吸着用プレート１３とは、互いに近づく所定断面積の延伸部１２ｄ，１３ｄを有し、延伸部１２ｄ，１３ｄの先端面間は、幅可変素材１５の幅に略等しい幅の間隙部１６になっている。

【００２９】半導体基板取付部１３ｂは湾曲形状を維持し、かつ幅可変素材１５の同一駆動により同一の湾曲面形状を再現することが好ましいので、十分な弾性を有し、容易に塑性変形を起こさない材質であることが望ま

れる。また、湾曲した半導体基板取付部１３ｂは幅可変素材１５の位置で支持されて加工圧力を受け、この加工圧力が半導体基板取付部１３ｂに伝わるので、半導体基板取付部１３ｂは剪断応力に十分に耐え得る素材であることが望まれる。更に、半導体装置製造プロセスは半導体素子の信頼性を確保するために金属不純物の混入を極端に嫌うので、半導体基板取付部１３ｂの材質として金属成分を含んでいる場合には半導体基板との当接部に金属不純物の遮蔽膜を形成することが好ましい。従って、特に、半導体基板取付部１３ｂはステンレス鋼又はリン青銅で形成されており、かつ外表面１３ｃはテフロンコートされていることが好ましい。ここにテフロンとはポリテトラフルオロエチレンをいう。なお、半導体基板取付部１３ｂは耐圧力性に富み、弾性材質であればプラスチックを用いてもよい。なお、半導体基板取付部１３ｂは基板吸着用プレート１３本体と一体に形成されてもよく、また別個に製作して基板吸着用プレート１３本体に固定（図示省略）されてもよい。次に、吸着孔１８は半導体基板取付部１３ｂと同軸に、基板固定用ガイド１３ａに比較的に近い位置の所定径（例えば半導体基板の径の２／３の径）の円周上に８個設けてある。そして吸着孔１８は空間部１４内で不図示のチューブに連結され、更に不図示の真空ポンプに接続され、これを駆動することにより吸着孔から外気を吸い込む。この吸引力により半導体基板は外表面１３ｃに吸い付けられてハンドリング，搬送される。外表面の湾曲面形状１３ｃは、第１実施例と同様に、吸着力及び研磨布からの押し返し力により半導体基板の形状が押圧力がより均一な所定の湾曲面形状になるように、その形状が決定される。

【００３０】間隙部１６には幅可変素材１５が取り付けられる。幅可変素材１５とは、電気力や磁力等の制御力を作用させて、その幅を可変可能な素材のことであり、例えば、ピエゾ素子，超磁歪合金等を用いる。制御力により幅可変素材１５を駆動させると、幅可変素材１５の幅が大きくなり、延伸部１２ｄ及び１３ｄの先端面に当接して、延伸部１２ｄ，１３ｄ間を押し広げようとするので、半導体基板取付部１３ｂ、即ちその外表面１３ｃが湾曲面形状となる。

【００３１】次に、研磨布の種類，加工圧力，半導体基板の厚さ・種類等の研磨条件と、そのときに求める圧力分布が得られる幅可変素材の幅との関係を、テーブルデータとして作成しておく。

【００３２】このように構成してあり、半導体基板を外表面に吸着させる前，吸着させた後又は研磨布に押圧した後に、研磨布の種類，加工圧力，半導体基板の厚さ・種類等の研磨条件により、テーブルデータに基づいて、幅可変素材の設定幅を定め、この幅となるように制御力を作用させる。すると、半導体基板を研磨布に押圧した状態において、第１実施例と同様に、吸着力及び研磨布からの押し返し力によって、半導体基板に所定の湾曲面

形状が形成され、この状態で、研磨を行う。これにより、目的とする均一な研磨量分布の半導体基板が得られる。次に、研磨条件が変わった場合にはテーブルデータにより幅可変素材１５の幅を変えて、これにより研磨を行う。

【００３３】なお、半導体基板取付部１３ｂをステンレス鋼又はリン青銅で形成したので、所定の湾曲面形状を維持し、かつ繰り返し再現性が確保される。また外表面１３ｃはテフロンコートされているので、本研磨装置の使用において外表面１３ｃに吸着される半導体基板への金属不純物の混入が大きく防止される。

【００３４】本実施例において、幅可変素材の数と位置は、外表面の湾曲面形状が最適となるように設定することができる。例えば図６は半導体基板取付部２３ｂの中心部に１個，半導体取付部２３ｂの中心と端部との略中間の位置に円周状に等間隔に８個の幅可変素材２５を設けたものである。そして、中心と端部との略中間の位置に配置された８個の幅可変素材２５の設定幅を、中心部の幅可変素材２５の設定幅より小さい幅とすることにより、中心と端部との略中間の位置付近においても十分に好ましい曲率を持った、最適な外表面２３ｃの湾曲面形状を得ることができる。

【００３５】次に本発明の第３実施例を説明する。図１において、基板吸着用プレート３３には、径方向に基板固定用ガイド３３ａの内端面３３ｄの延長線上にまで伸び、軸方向に外表面３３ｃの近傍にまで伸びた空間部３４が形成されている。そして、空間部３４内に、中心部に１個，半導体基板取付部３３ｂの中心と端部との間の距離の約３等分の各位置にそれぞれ、円周状に等間隔に６個及び８個の幅可変素材３５が、研磨用回転キャリア３２に固着して配置してある。そして各幅可変素材３５の先端面の中心部と半導体基板取付部３３ｂとの間に硬球３７が配置してある。硬球３７は幅可変素材３５に固着してあってもよく、半導体基板取付部３３ｂに固着してあってもよく、双方に固着してあってもよく、また、空間部３４内に配置された１個の保持器（図示省略）の各孔に硬球３７を配置して硬球３７を幅可変素材３５及び半導体基板取付部３３ｂのいずれにも固着せずに保持してもよい。硬球３７には硬い材質が用いられ、例えば鋼等の金属球等が用いられる。

【００３６】次に、基板固定用ガイド３３ａの外側において基板固定用ガイド３３ａの外端面３３ｅの延長上の位置まで、かつ、全円周に亘って、切欠部３３ｆが形成されており、所定肉厚の半導体基板取付部３３ｂがその肉厚のまま基板固定用ガイド３３ａの外側まで延長された構成になっている。

【００３７】他の構成は第２実施例と同様であるので、説明を省略する。

【００３８】本実施例はこのように構成してあり、幅可変素材３５を駆動すると、各幅可変素材はその制御力に

9

応じた幅の拡大を生じ半導体基板取付部３３ｂの外表面３３ｃを所定の湾曲面形状にする。幅可変素材３５を中心部の他に、基板取付部３３ｂの径の約３等分の各円周上にも配置してあるので、これらの部分においても十分に好ましい曲率を持った外表面３３ｃが得られる。また、幅可変素材３５の平担先端面を直接基板取付部３３ｂに接触させる場合には幅可変素材３５の平担先端面の部分で基板取付部３３ｂが平担面になり、外表面３３ｃの湾曲面からこの平担面になるところで湾曲の急変が生じ、従って圧力分布に歪みができて、研磨むらを生じるおそれがあるが、本実施例では、幅可変素材３５の幅の拡大は鋼球３７を介して点接触で基板取付部３３ｂに伝えられるので上記の問題が生じず歪みのない圧力分布が得られる。更に、基板取付部３３ｂが湾曲するときに基板吸着用プレート３３の基板取付部３３ｂ外側の部分の剛性が高いと、基板取付部３３ｂの端部リング状部分で基板取付部３３ｂが十分に湾曲できず、即ちこのリング状部分で平担面となりこの部分の圧力分布が大きくなるが、切欠部３３ｆが設けてあるので、切欠部３３ｆがせばまることにより、基板固定ガイド３３ａ近傍を支点として基板取付部３３ｂの端部リング状部分でも十分に回転して、この部分の十分な湾曲が可能になる。なお、上記のリング状部分で圧力が高いと基板中心部に向かう研磨剤の供給量が減少し基板中心部の研磨除去速度の低下の原因になるが、上記の切欠部３３ｆを設けることにより基板中心部に十分に研磨剤を供給することが可能になる。

【００３９】上記実施例において半導体基板の湾曲は吸着孔からの吸着力及び研磨布からの押し返し力の双方の力により行うとしたが、半導体基板の湾曲を研磨布からの押し返し力のみにより行ってもよい。

【００４０】本発明は、半導体基板の研磨圧力を面内の各部分で変化させて研磨を行う場合にも利用することができる。即ち、例えば、半導体基板の表面に所定厚さの膜を形成した場合にその膜厚に不均一性があった場合に、この不均一性に対応させて、半導体基板取付部の外表面を所定形状に湾曲させ、これに半導体基板を当接して、半導体基板を湾曲させると、膜厚の厚いところおよび薄いところでそれぞれ研磨布との押圧力を大きくおよび小さくすることができ、従ってこれにより研磨を行うと、厚い膜厚の部分をより多く研磨し、薄い膜厚の部分をより少なく研磨し、従って、残膜厚をより等しくすることができる。このように本発明は半導体基板の面内の研磨圧力の高精度な制御に利用することができる。

10

【００４１】

【発明の効果】本発明は以上のように構成したので、研磨圧力分布をより高精度に制御することができ、従って、半導体基板の研磨加工においてその研磨量を高精度に制御することが可能になる。

【図面の簡単な説明】

【図１】本発明の第３実施例の要部の説明図であり、同図（ａ）は断面図，同図（ｂ）は下面図である。

【図２】本発明の第１実施例の要部の説明図であり、同図（ａ）は断面図，同図（ｂ）は下面図である。

【図３】本発明の第１実施例において、半導体基板の湾曲の割合を変えた場合の半導体基板中心部と半導体基板周辺部との研磨除去速度の違いを示すグラフである。

【図４】図３のグラフにおいて、半導体基板の湾曲の割合を変えた場合の研磨除去速度の均一性の程度を示すグラフである。

【図５】本発明の第２実施例の要部の説明図であり、同図（ａ）は断面図，同図（ｂ）は下面図である。

【図６】本発明の第２実施例の他の形態の要部の説明図であり、同図（ａ）は断面図，同図（ｂ）は下面図である。

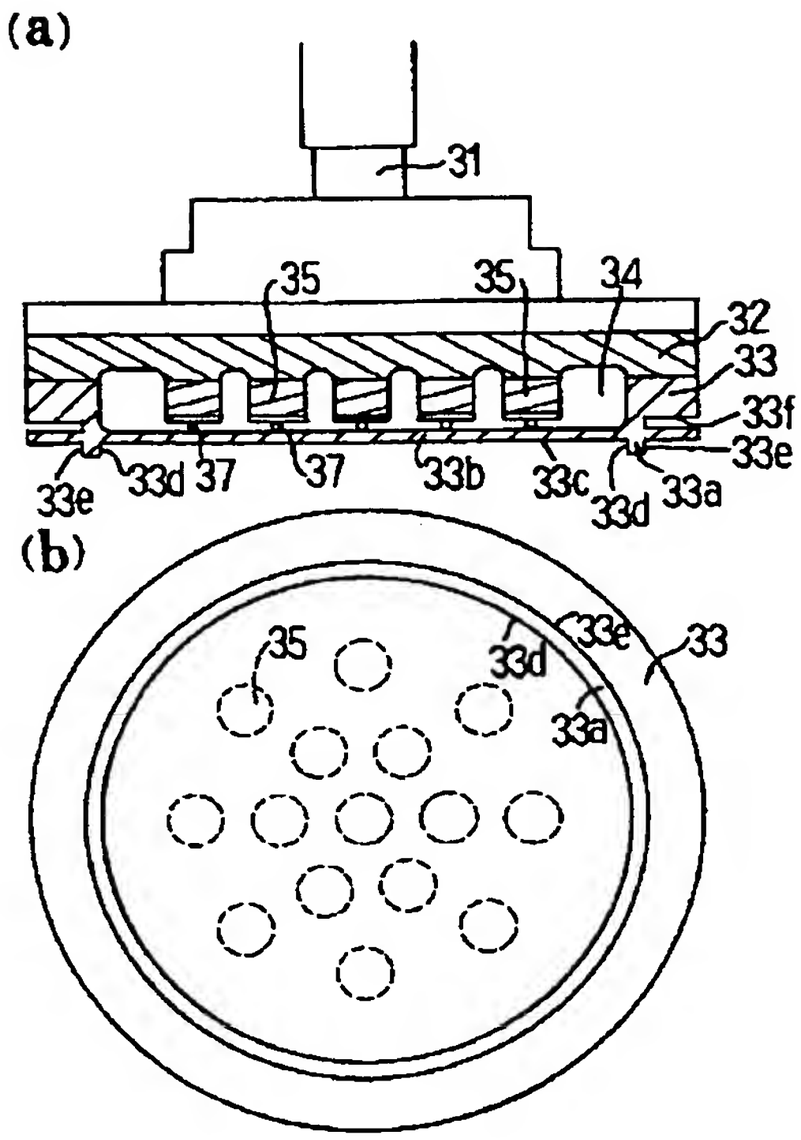
【図７】研磨定盤の回転と研磨用回転キャリアの回転の相対的関係の説明図である。

【図８】従来の研磨における加工断面形状及び基板内圧力分布の変化の様子を示す説明図である。

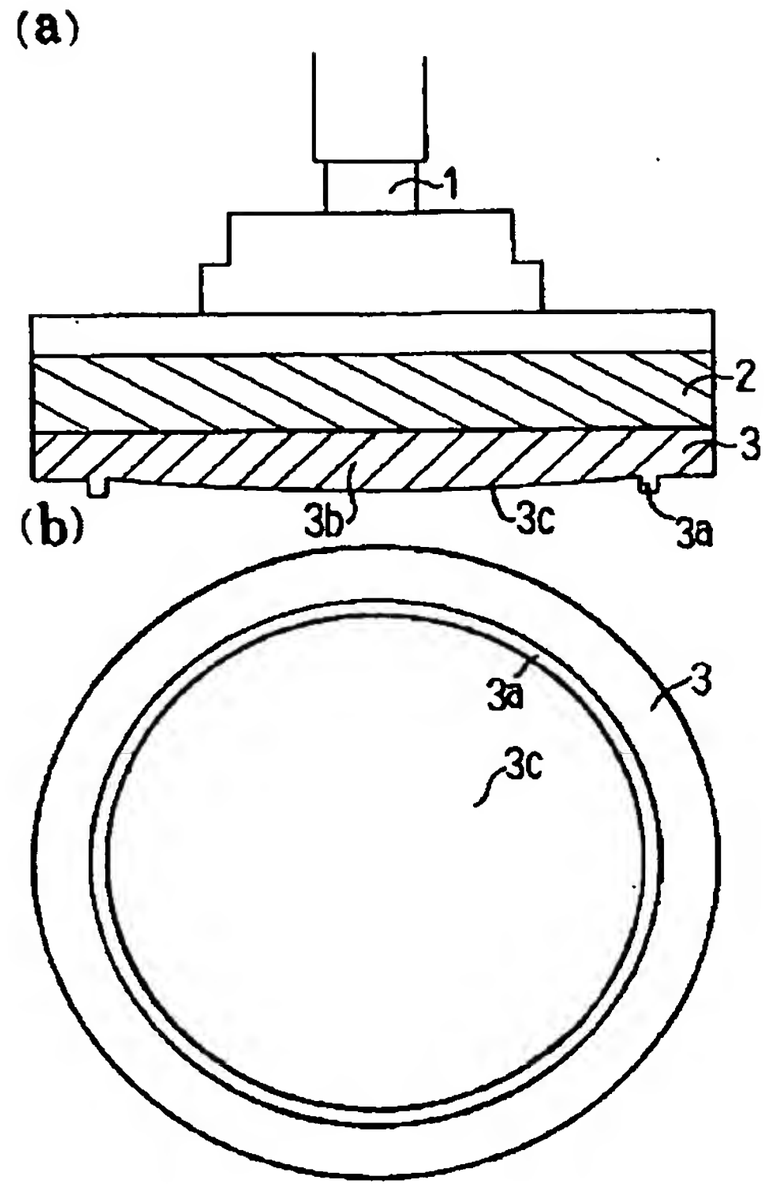
【符号の説明】

２，１２，３２　研磨用回転キャリア
３，１３，３３　基板吸着用プレート
３ｂ，１３ｂ，２３ｂ，３３ｂ　半導体基板取付部
３ｃ，１３ｃ，２３ｃ，３３ｃ　外表面
１５，２５，３５　幅可変素材
３７　硬球
３３ｆ　切欠部

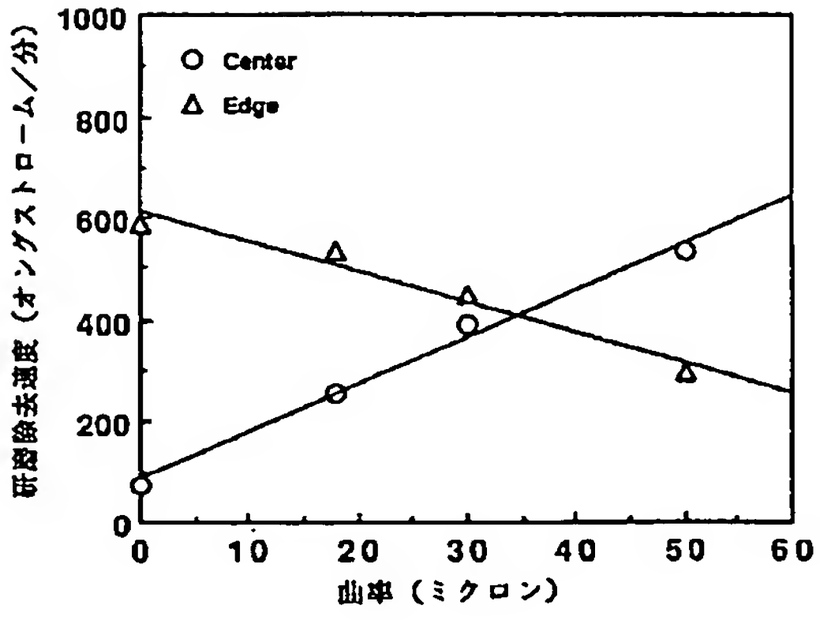
【図１】


(a)
31
35
35
34
32
33
33f
33e
33e
33d
37
37
33b
33c
33d
33a
(b)
35
33d
33e
33
33a

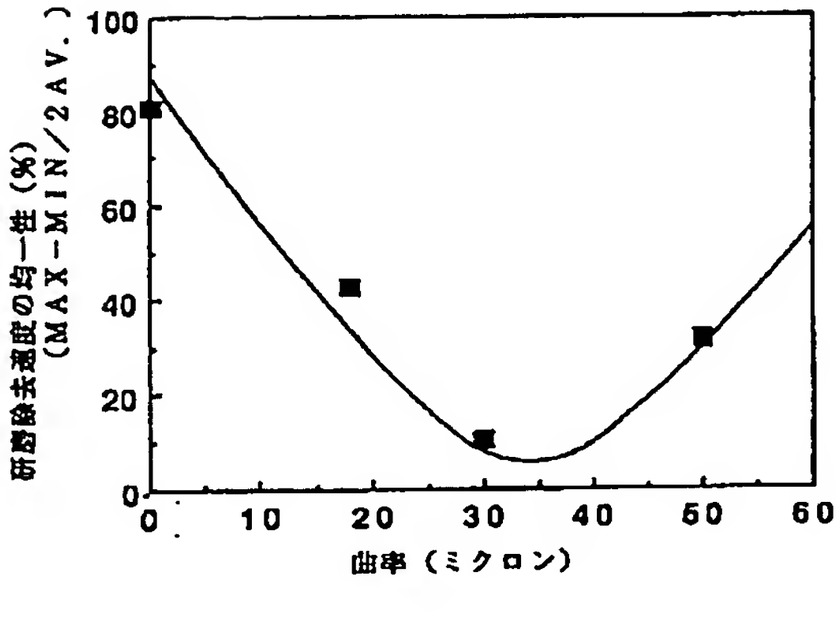
【図２】


(a)
1
2
3
(b)
3b
3c
3a
3a
3
3c

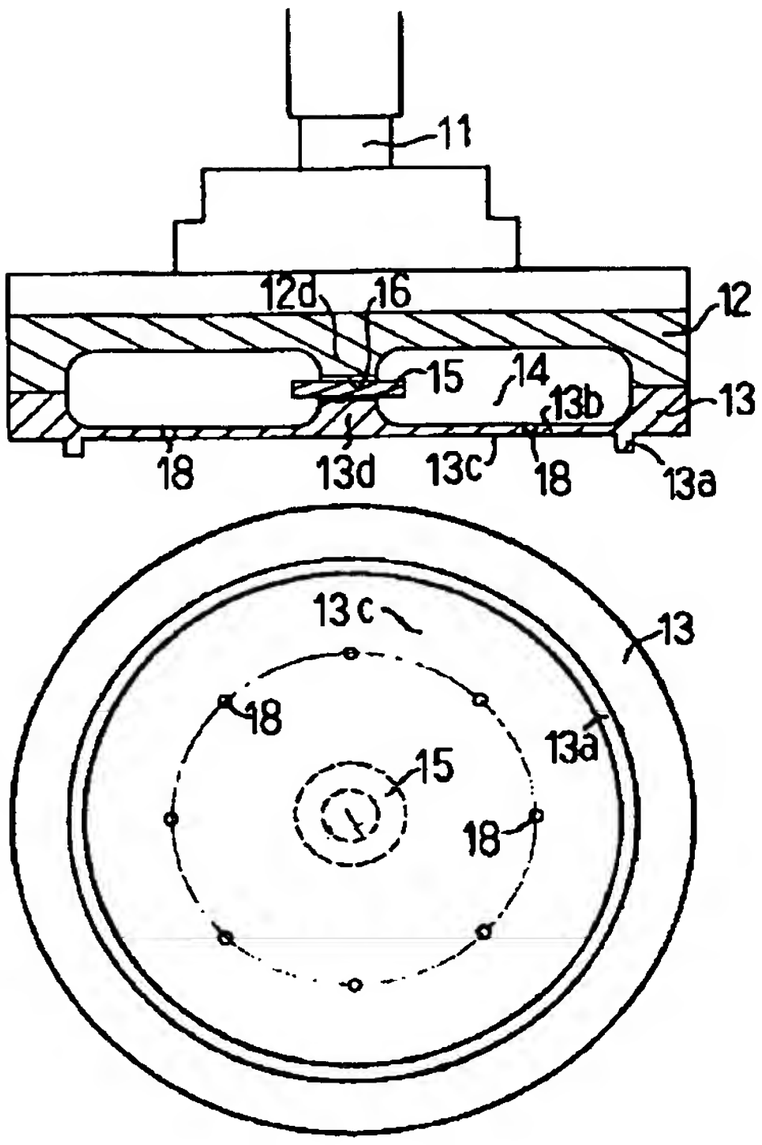
【図３】


1000
800
600
400
200
0
Center
Edge
研磨除去速度（オングストローム／分）
0
10
20
30
40
50
60
曲率（ミクロン）

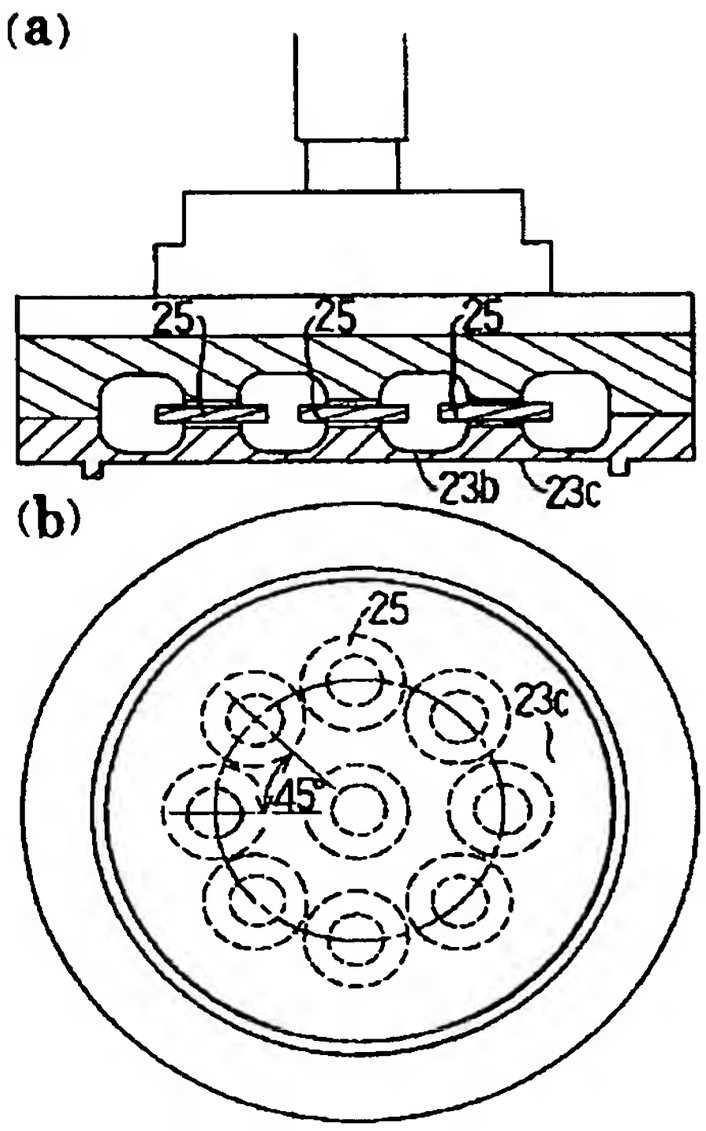
【図４】


100
80
60
40
20
0
研磨除去速度の均一性（%）
（MAX−MIN／2AV.）
0
10
20
30
40
50
60
曲率（ミクロン）

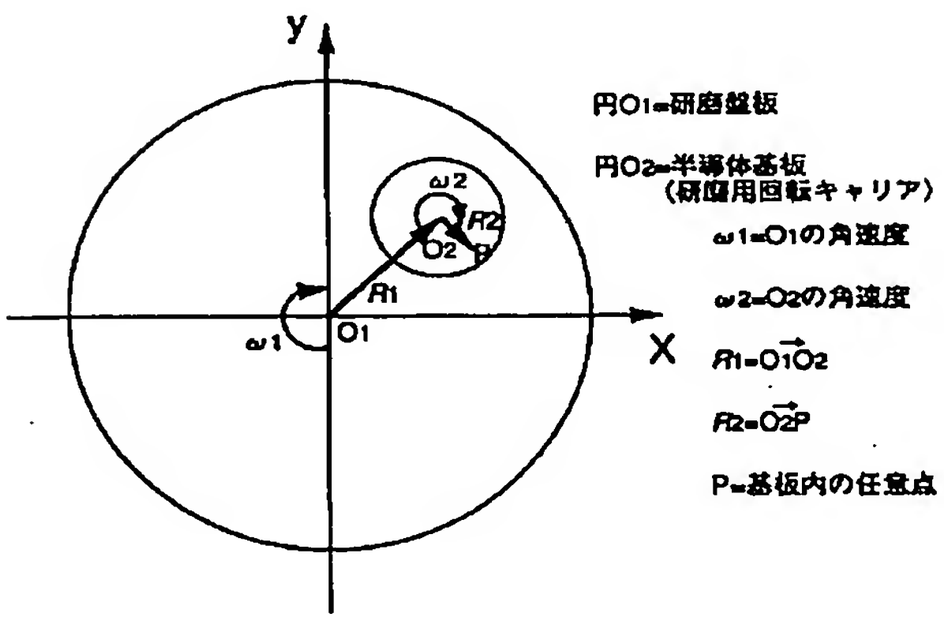
【図５】


11
12d
16
12
15
14
13b
13
18
13d
13c
18
13a
13c
13
18
15
13a
18

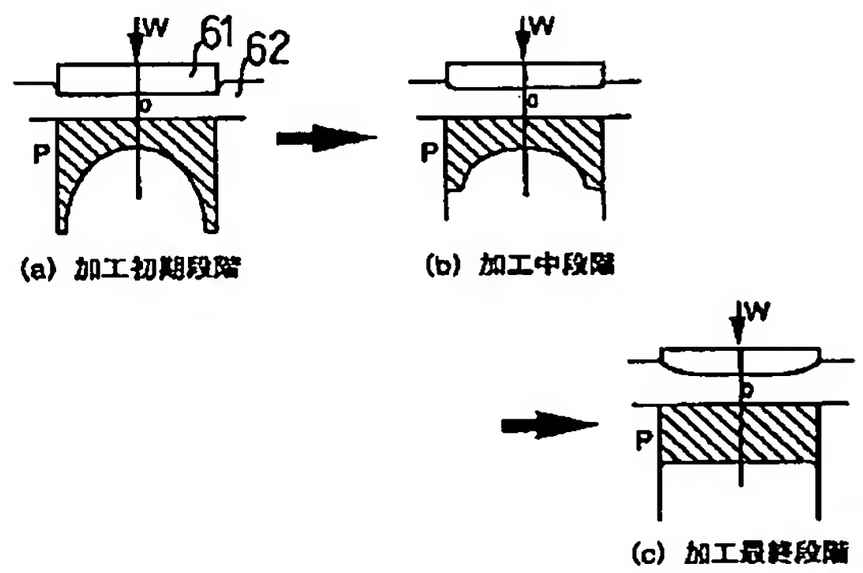
【図６】


(a)
25
25
25
23b
23c
(b)
25
23c
45°

【図７】


y
X
ω2
R2
O2
P
R1
ω1
O1
円O1=研磨盤板
円O2=半導体基板
(研磨用回転キャリア)
ω1=O1の角速度
ω2=O2の角速度
R1=O1O2
R2=O2P
P=基板内の任意点

【図８】


W
61
62
P
(a) 加工初期段階
W
P
(b) 加工中段階
W
P
(c) 加工最終段階